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UNITED STATES DEPARTMENT OF AGRICULTURE

Substitutes for Scarce Materials

CONTENTS

INTRODUCTION

In the course of their everyday work farmers use a wide range of materials, many of which are now scarce or unavailable.

For some of these materials, common sense or ingenuity will suggest substitutes. If a farmer cannot get galvanized roofing, he may use roofing paper or some kind of shingle; if he cannot get a certain repair part for a machine, he may be able to make it.

It is very often unsafe, however, to rely on common sense or ingenuity, to suggest the proper substitute for a medicine to be used in treating an animal disease, or for a fungicide needed in combating a disease of plants. Expert knowledge is often required, but even the experts are sometimes stumped to give a real substitute for some commonly used drug or chemical. In some cases there is no substitute, or none that is entirely satisfactory. Scientists are working hard to discover new materials that will do the job for many of those now scarce or lacking, but the necessary experiments take considerable time.

This pamphlet gives information on possible substitutes for some of the principal scarce materials used as disinfectants, livestock medicines, feed supplements, fungicides for plant diseases, fertilizers, and insecticides for plants, animals, and human beings. It is by no means a complete listing of all the materials that are scarce or may become scarce during the war. The primary purpose in preparing the lists was to supplement the recommendations given in Farmers' Bulletins and other Department publications written before the war, wherever these recommendations did not deal adequately with the question of alternatives for materials ordinarily used.

Fortunately, in some cases there are priorities which permit those concerned to obtain scarce materials needed. In some cases, too, supplies may be available in one locality though not in another. The situation is shifting and uncertain, however.

This pamphlet offers such guidance in making substitutions for certain scarce materials as can be given at the present time. In the case of insecticides, in particular, almost all materials now used are scarce or likely to become scarce, but conditions vary locally and at

Note.—Many of the chemicals mentioned in this pamphlet are poisonous, and every precaution for safety should be taken in using them. Proper warnings are usually given on the package, or directions for safe use may be obtained from official publications or local authorities.

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different times. Hence it was thought best to list the alternative materials for each insecticide mentioned, even though one or more of the alternatives might not be available in certain areas or at certain times.

When in doubt the reader should consult his county agricultural agent, a State or Federal specialist, or a county or State war board. Letters of inquiry may also be addressed to the United States Department of Agriculture, Washington, D. C.

MATERIALS NEEDED FOR LIVESTOCK

Material relating to livestock needs that probably will be difficult to obtain for the duration of the war are:

Metallic substances, especially those containing arsenic, boron, calcium, copper, iron, magnesium, manganese, mercury, potassium, and zinc.

Chemicals containing chlorine and phosphorus and compounds related to or derived from alcohol, ammonia, camphor, formaldehyde, glycerine, quinine, and like products.

Material related to sugar, such as molasses, and those related to various oils, especially fish oils and linseed oils, likewise rubber, petroleum products, and various kinds of manufactured farm equipment.

Whenever the health of domestic animals is involved, it is advisable to obtain local veterinary assistance. A diseased condition, especially if infectious, should receive immediate professional attention. Veterinarians are able, through priorities granted them, to obtain certain supplies not readily available to the public.

The following suggestions relate, therefore, to substitutes involving general rather than emergency needs. Attention is directed also to the importance of knowing the purpose for which the substitute material is intended.

Feed Supplements

Fish-liver oils.—Cod-liver and other fish-liver oils are used in poultry feeding as a source of vitamin D. Sun-cured hays and access of poultry to direct sunlight are recommended substitutes. Feeding vitamin-D-activated animal sterols, now available in solid or liquid form, is likewise a satisfactory procedure.

Molasses.—When plentiful and moderately priced, molasses is used largely as an appetizer to obtain greater consumption of the less palatable feeds. It has some preserving value as an ingredient of silage. Other feeds rich in carbohydrates are fair substitutes.

Mineral and mineral salts.—For best growth and development animals require small quantities of essential mineral substitutes, particularly iron, copper, and phosphorus. Small quantities of magnesium, manganese, and zinc are likewise beneficial. Young animals need these elements more but older ones get various physiological benefits from them. There are no substitutes for the essential elements, but fortunately a well-balanced ration supplies most of them. When a nutritional deficiency is suspected, the producer should consult a county agricultural agent or publications on livestock feeding.

Medicinal Remedies

Ammonia.—Concentrated ammonia water, U. S. P. (not household ammonia), is used to neutralize the irritating effects of formaldehyde gas after the disinfection with that gas of such equipment as incubators and stables. There is no recommended chemical substitute, but the irritating effects of the gas on attendants may be minimized by ventilation.

Arsenic.—An aqueous solution of potassium arsenite, known as Fowler's solution, is used internally for the treatment of severe cases of warts in cattle and various ailments of sheep and goats. There is no substitute for the treatment except to isolate the animals or to send them to slaughter.

Bichloride of mercury.—This is a very powerful disinfectant, but it is not recommended for general use about the farm because of its disadvantages, chief of which is that it is **extremely poisonous.** Substitutes include compound solution of cresol, emulsified coal tar, lye, quicklime, and sodium orthophenylphenate. The last-mentioned material is recommended for use against tuberculosis, for which lye and chlorine are not effective.

Boric acid.—This mild antiseptic is useful in treating various diseases of livestock. In many cases other antiseptics, such as compound solution of cresol, may be used, the kind and strength depending on the nature of the ailment.

Calomel.—This drug is used in the treatment of certain diseases of swine, usually as a purgative. Substitutes include castor oil and Epsom salts.

Castor oil.—This oil is used largely for internal treatment of smaller farm animals when in need of this type of purgative. Substitutes include Epsom salts, Glauber's salt, and raw linseed oil.

Chloride of lime.—This common disinfectant, known as chlorinated lime and bleaching powder, is widely used on premises to destroy the infective agents of most livestock diseases. Substitutes for chloride of lime are compound solution of cresol, emulsified coal tar, lye, and quicklime. Sodium orthophenylphenate is recommended as a disinfectant for destroying the germs of tuberculosis.

Compound solution of cresol.—This product is a very useful general disinfectant against livestock diseases. Substitutes include formaldehyde, lye, quicklime, emulsified coal tar, and sodium orthophenylphenate. The last-mentioned substance is recommended for use against tuberculosis.

Copper sulfate.—This chemical is used as internal treatment for the removal of stomach worms and for other diseases of sheep. Phenothiazine is a substitute in case of stomach worms, but no substitutes are recommended for treatment of other diseases. Copper sulfate is used also for treating streams and swamps to eradicate certain snails that harbor one stage of the liver fluke. No other material has been found to serve the purpose well, but a substitute measure consists in draining such areas or keeping sheep and cattle away from them.

Epsom salts.—This chemical substance is familiar as a purgative for practically all farm animals because of its availability and effectiveness. Substitutes include Glauber's salt, castor oil, and linseed oil.

Iodine, tincture of.—This antiseptic has a variety of uses in the treatment of wounds and other ailments of livestock. As substitutes for dressing wounds, use compound solution of cresol or emulsified coal tar. Only small quantities are used for other medicinal purposes.

Linseed oil.—Raw linseed oil is used for internal treatment of farm animals when a purgative is required. Substitutes include castor oil and Epsom salts or Glauber's salt.

Phenol.—Commonly known as "carbolic acid," this material is used as a disinfectant for destroying the germs of most livestock diseases but does not appear to be effective against hog-cholera virus. Substitutes include compound solution of cresol, emulsified coal tar, lye, and quicklime.

Potassium iodide.—No substitutes are recommended for this drug used for treating various diseases of sheep and goats and certain diseases of cattle. Only small quantities, however, are required.

Potassium nitrate.—This drug is used for treating pleurisy of swine. No substitutes are recommended, but only small quantities are required.

Potassium permanganate.—A mixture of formalin and this chemical generates formaldehyde gas for the disinfection of incubators or stables. Formalin alone is a substitute for disinfecting incubators.

Sodium iodide.—This is particularly effective against actinobacillosis, a form of lumpy jaw. There is no effective substitute.

Sodium nitrite.—This chemical is used principally in treating animals poisoned by eating plants that produce hydrocyanic acid. Substitutes include methylene blue and sodium thiosulfate, either of which should be used only under veterinary supervision.

COMBATING PLANT DISEASES

Many materials once available for use as fungicides are now scarce or unobtainable for civilian purposes. For some of these there are no satisfactory substitutes, but in many cases needs can be met by using other materials. Probably in most cases an effective substitution will be difficult, either because of lack of materials or the unsuitability for the purpose of those available. Furthermore, some proposed substitutes—spray materials, for example—may be either harmful or ineffective. Great caution should therefore be exercised in their use, particularly in the case of those untested for the proposed service.

FUNGICIDES

Substitutes here listed are shown for certain of the scarce fungicides. Spergon is to be applied at a rate of 2 ounces per bushel unless recommended otherwise on the package.

Bismuth subsalicylate.—Fermate may be substituted for bismuth subsalicylate in control of blue mold of tobacco.

Copper carbonate dust.—Arasan or Spergon may be substituted for copper carbonate dust in control of covered and loose kernel smuts, seed rotting, seedling blight, and wilt of broomcorn, sorghum, and Sudan grass; of seedling blight of cotton; and of bunt and stinking smut of wheat.

Copper oxide (cuprous oxide).—Spergon or Arasan may be substituted for copper oxide in the treatment of vegetable seeds to control pre-emergence damping-off. Use as directed on the package. Fermate may be substituted in control of blue mold of tobacco.

Copper sulfate.—Arasan or Spergon may be substituted for copper sulfate in control of covered and loose kernel smuts, seed rotting, seedling blight, and wilt of broomcorn, sorghum, and Sudan grass; and of bunt and stinking smut of wheat. Whitewash or paint may be substituted for copper sulfate on sweetpotato houses, crates, and hampers. For fumigating sweetpotato houses sulfur should be burned at the rate of ¾ to 1 pound per 1,000 cubic feet of space in any convenient metal container which is properly supported off the floor to avoid setting fire to the structure. Doors, vents, and windows of the house should be kept tightly closed for about 24 hours during this treatment. Light spraying of the inside of the house with water a day or two before adds to the effectiveness of the treatment.

Corrosive sublimate (mercuric chloride, bichloride of mercury).—The hot-water treatment of seed described in Farmers' Bulletin 1862, Vegetable Seed Treatments, may be substituted for corrosive sublimate in control of blackleg and black rot of cabbage and of bacterial spot and early blight of tomato. A 1 : 1,000 solution of silver nitrate may be substituted for corrosive sublimate in control of leaf spot disease of tobacco.

Ethyl mercuric phosphate.—Arasan or Spergon may be substituted for ethyl mercuric phosphate in control of covered and loose kernel smuts, seed rotting, seedling blight, and wilt of broomcorn, sorghum, and Sudan grass; for damping-off, rot, seedling blight, and sore shin in treating cottonseed; and of bunt and stinking smut of wheat. The hot-water treatment described in Farmers' Bulletin 1862, Vegetable Seed Treatments, may be substituted for ethyl mercuric phosphate in control of bacterial spot and early blight of tomato.

Formaldehyde.—Arasan or Spergon may be substituted for formaldehyde in control of covered and loose kernel smuts, seed rotting, seedling blight, and wilt of broomcorn, grain sorghum, and Sudan grass.

Formalin plus potassium permanganate.—See discussion of fumigating sweetpotato houses under Copper Sulfate.

Hydrochloric acid gas.—Re-ginning instead of hydrochloric acid gas may be used partly to remove seed fuzz of cottonseed so that corn planters and other hill-planting equipment may be used in control of seedling diseases. Spergon also may be substituted.

Paradichlorobenzene.—Xylol or benzol may be substituted in seedbed treatment in control of blue mold of tobacco. See Farmers' Bulletin 1799, Blue Mold (Downy Mildew) Disease of Tobacco, for rates of application.

Phenol mercury compounds.—For pea seed, substitute Spergon.

Semesan.—Spergon or Arasan may be substituted for Semesan in the treatment of vegetable seeds to control pre-emergence damping-off. Use as directed on the package.

FERTILIZER SUPPLY

All plants need various plant-food elements in the soil solution in order to grow. The elements most frequently deficient in quantity for maximum yields are nitrogen, phosphorus, and potassium. In general it makes little difference what fertilizer material is used to supply these elements, provided they are present in a form readily utilized by plants.

The supply of fertilizer materials, except for potash, will be larger during the year July 1, 1943, to June 30, 1944, than in any previous year, but the need is greater than last year when the demand exceeded the supply. The total estimated fertilizer consumption will be about 10 percent greater than in 1943, or about 10,500,000 tons. The supply of nitrogen and phosphoric acid seems adequate for this amount, but there may be a slight deficit of potash.

A serious shortage in nitrogen supply has been averted through the release of ammonium nitrate by munitions plants; about 230,000 tons of nitrogen in this form will be used in 1944. The commercial ammonium nitrate contains about 32 percent nitrogen, or twice as much as sodium nitrate (nitrate of soda).

If a farmer should be unable to obtain a nitrogenous material that he is accustomed to buying, he will do well to take any other that may be obtainable. In many cases about the same results may be obtained by applying the same quantity of nitrogen in some other material. Different materials contain different percentages of nitrogen and this should be kept in mind in using substitutes.

The average nitrogen content of some common fertilizer materials is as follows:

	Percent nitrogen		*Percent nitrogen*
Ammonium nitrate	32. 0	Cottonseed meal	6. 5
Nitrate of soda	16. 0	Castor pomace	5. 0
Nitrate of soda—potash	15. 0	Soybean meal	7. 0
Sulfate of ammonia	20. 7	Peanut meal	7. 0
Ammo-phos A	11. 0	Fish scrap	9. 0
Ammo-phos B	16. 0	Animal tankage	8. 0
Calcium nitrate	14. 0	Dried blood	14. 0
Cyanamid, powdered	22. 0	Activated sewage sludge	5. 5
Cyanamid, granular	21. 0	Horn and hoof meal	14. 0
Uramon	42. 0	Process tankage	9. 0

Some of these materials contain other plant-food elements besides nitrogen. Demands for nitrates to be used in munitions emphasized anew the farm practices that tend to reduce the needs for commercial nitrogen. American farmers have long been familiar with the values of legumes in adding nitrogen to the soil, and much attention has been called in recent years to the neglect in this country of the fertilizer values of farm manure. Although the supply of nitrogen materials seems sufficient at present for commercial fertilizers, good farm practices still require adequate use of legumes and proper conservation of farm manures.

CONTROL OF INSECTS AFFECTING PLANTS, ANIMALS, AND MAN

There are so many different species of insects with diverse habits and different degrees of resistance against various insecticides that the presentation of information regarding insecticide substitutes becomes very complicated.

In very few cases can one insecticidal material be said to be a complete substitute for another. Certain substances may be highly effective against one insect and of little value against another. Furthermore, some plants are very sensitive to certain insecticidal materials and may be seriously damaged by them. In some instances an insecticide useful in a given region may be ineffective or harmful to plants in another region where climatic conditions are different. Another factor which must be considered is the availability of machinery for applying insecticides of different types or in different forms, and the cost of the insecticides or their application under different crop conditions. An even more important factor is that of poisonous residues, which may render food crops unpalatable or positively dangerous.

The numbers of many destructive insects may be reduced by the use of measures other than the application of insecticides. Among these control methods might be mentioned crop rotation, modified cultural practices, field sanitation, the use of insect-resistant varieties, and taking advantage of seasonal factors. The various publications of the United States Department of Agriculture dealing with insect control in most cases point out ways in which insect damage may be minimized through control methods not involving the use of insecticides.

Some materials that might be assumed to be effective against certain pests do not prove so in practice. They may be harmful to the infested plants or animals, and there is danger attached to the use of materials prepared for certain purposes. It is, therefore, inadvisable for anyone to attempt to use substitute materials without sufficient knowledge. It cannot be too strongly emphasized that most materials used against insects are poisonous to man and animals, and that they should be used with proper precautions, as pointed out in the bulletins recommending them. Some, such as hydrocyanic acid gas, certain other fumigants, and thallium sulfate, are so dangerous that their use should be restricted to those especially trained in their handling.

A number of materials used as insecticides are not listed herein, and many insects of economic importance are also omitted, although the list covers the more destructive ones.

The information in this pamphlet does not cover all cases or present all of the limiting factors. In general, under the name of the most satisfactory insecticide

are presented in the following list the substitutes in the approximate order of their efficacy and desirability.

INSECTICIDES

Ammonium Sulfate.

Earthworms.—(For use in greenhouses only.) Limewater (2 cupfuls quicklime, 3 gallons water) tobacco dust in soil; see also LEAD ARSENATE.

Anthracene Oil.

Fowl ticks and chicken mites.—Creosote oil (less persistent and must be handled with greater care because of its caustic effect on the operator); crude petroleum (less effective and persistent; applications must be repeated more often); used crankcase oil (less effective than others); kerosene emulsion (less persistent than others, but it does not stain wood or injure poultry).

Aluminum Sulfate.

Japanese beetle (adult).—See LEAD ARSENATE.

Arsenic (White or Crude).

Armyworms.—See SODIUM ARSENITE.
Cranefly.—See PARIS GREEN.
Cutworms.—Sodium fluosilicate; sodium arsenite; paris green.
Grasshoppers.—See SODIUM ARSENITE.
Silverfish.—(In bait) sodium fluoride (do not add moisture); (as a dust) pyrethrum powder; (as a spray) paradichlorobenzene in carbon tetrachloride (close rooms for 24 hours). Phosphorus paste.
Slugs and snails.—See METALDYHYDE.

Arsenical Dips (Sodium Arsenite).

Ticks, lice, and sheep ticks on livestock.—Nicotine sulfate (use with care on sheep); rotenone dips; coal-tar creosote dips; wettable sulfur and rotenone dips; sodium fluoride (effective against biting lice only and burns mucous membranes); sulfur with wetting agent (for goat louse only). Used as sprays or dips. There is no substitute for arsenical dip for cattle ticks.
Dogs.—See ROTENONE-BEARING MATERIALS.

Barium Fluosilicate.

Codling moth.—See LEAD ARSENATE.
Flea beetles.—See ROTENONE-BEARING MATERIALS.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Plum curculio (on peach).—See LEAD ARSENATE.
Sweetpotato leaf beetle.—See CALCIUM ARSENATE.
Vegetable weevil.—See CALCIUM ARSENATE.

Bordeaux Mixture.

Cucumber beetles.—See ROTENONE-BEARING MATERIALS.
Flea beetles.—See ROTENONE-BEARING MATERIALS.
Leafhoppers.—(Especially on potatoes, beans, and peanuts.) Pyrethrum, sulfur (effective against certain species only; may cause injury to foliage of certain plants such as cucurbits and the fruit of raspberries).

Brown Sugar.

Ants.—(As attractant in baits.) White sugar; honey.
Gladiolus thrips.—(Used with tartar emetic, nicotine, lead arsenate, or paris green as sprays.) Blackstrap molasses; cane, corn, or sorghum sirup; honey.

Calcium Arsenate.

Alfalfa weevil.—Zinc arsenite; lead arsenate (cultural control effective in most areas.)
Apple maggot.—See LEAD ARSENATE.
Asparagus beetles.—See ROTENONE-BEARING MATERIALS.
Blister beetles.—See ROTENONE-BEARING MATERIALS.
Boll weevil.—No adequate substitute. See MOLASSES.
Bollworm on cotton.—Lead arsenate (probably better than calcium arsenate but more expensive); cryolite.
Cabbage caterpillars.—See ROTENONE-BEARING MATERIALS.
Codling moth.—See LEAD ARSENATE.
Colorado potato beetle.—Paris green; lead arsenate; cryolite; rotenone.
Cotton leafworm.—Lead arsenate; paris green (more effective than calcium arsenate; addition of 3 parts slaked lime to 1 part paris green reduces chance of burning foliage); cryolite (less effective).

Cucumber beetles.—See ROTENONE-BEARING MATERIALS.
Flea beetle.—See ROTENONE-BEARING MATERIALS.
Grape berry moth.—See LEAD ARSENATE.
Hornworms on tomatoes.—Hand picking; cryolite (less effective).
Lettuce looper.—See ROTENONE-BEARING MATERIALS.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Mole crickets.—(For use in bait.) Sodium fluosilicate (superior to calcium arsenate for the Puerto Rican and southern mole crickets).
Pea weevil.—See ROTENONE-BEARING MATERIALS.
Pecan leaf casebearer.—Lead arsenate; tar-oil sprays (in dormant period).
Pepper weevil.—Cryolite (more effective than calcium arsenate but, as is the case with calcium arsenate, peppers must be washed before being marketed or processed).
Plant bugs on cotton.—See PARIS GREEN.
Slugs and snails.—See METALDEHYDE.
Strawberry weevil.—Do not use calcium arsenate on strawberry after fruits begin to form; cryolite; rotenone (dust mixture containing rotenone and sulfur) (less effective).
Sweetpotato leaf beetle.—Cryolite; barium fluosilicate.
Tent caterpillar and other shade tree defoliators.—See LEAD ARSENATE.
Tobacco flea beetle.—See PARIS GREEN.
Tomato fruitworm.—See CRYOLITE.
Vegetable weevil.—Paris green; cryolite; lead arsenate; sodium fluosilicate; barium fluosilicate. See also SODIUM FLUORIDE.
Webworms (several species on beets and garden crops).—Paris green; pyrethrum. (See also PYRETHRUM, *Sod webworm.*)
White-fringed beetle.—(Usable on crops other than legumes); cryolite.

Calcium Arsenate-Sulfur Mixture.

Cotton fleahopper.—Sulfur (as a dust, less effective, especially against adults but will give good control).

Calcium Cyanide.

Ants.—See CARBON DISULFIDE, BROWN SUGAR, and SODIUM ARSENITE.
Cigarette beetle and tobacco moth (in closed tobacco warehouses).—Hydrocyanic acid gas; carbon disulfide (may be used in fumigating small quantities of infested stored tobacco; explosive); ethylene oxide-carbon dioxide mixture; methyl formate-carbon dioxide mixture (may be used in vacuum fumigation of stored tobacco); heat; cold storage (to prevent or hold infestations in check).
Gladiolus thrips (corms in storage).—(As a dip) mercuric chloride; (as a fumigant) naphthalene; ethylene dichloride-carbon tetrachloride mixture.
Grape leafhopper.—See NICOTINE SULFATE.
Greenhouse pests.—(Fumigation against certain pests.) Hydrocyanic acid gas.
Mushroom pests (including mushroom flies, mites, springtails, and sowbugs).—Sodium cyanide; hydrocyanic acid gas; pyrethrum; formaldehyde; dichloroethyl-ether; sulfur vapor; heat. See FORMALDEHYDE.
Stored-grain and cereal pests.—(In elevators, warehouses, and mills only.) (In elevators) ethylene dichloride-carbon tetrachloride mixture; carbon disulfide-carbon tetrachloride mixture; chloropicrin; ethylene oxide-carbon dioxide mixture. For warehouses and mills see HYDROCYANIC ACID GAS.
Weevils in beans and peas.—See CARBON DISULFIDE.
White flies.—See ROTENONE-BEARING MATERIALS.
Wireworms.—Naphthalene (effective soil fumigant when plowed or disked-in; more effective in sandy soils; should not be used after heavy application of barnyard manure or after plowing under green manure crops); carbon disulfide and dichloroethyl ether (see NAPHTHALENE).

Calcium Cyanamide. (For treating manure.) Use with acid phosphate. Or use borax or crude petroleum.

Carbon Dioxide. (See ETHYLENE OXIDE-CARBON DIOXIDE MIXTURE.)

Carbon Disulfide.

Ants.—Orthodichlorobenzene; calcium cyanide (used as dust about and in ant hills); pyrethrum sprays against adults; rotenone (derris) powder; methyl bromide (used for destroying colonies of the Texas leaf-cutting ant); poison baits. (See SODIUM ARSENITE, *Ants.*)

Carpenter ants.—See ROTENONE-BEARING MATERIALS.
Cigarette beetle and tobacco moth.—See CALCIUM CYANIDE.
Stored-grain insects.—See ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE.
Weevils in beans and peas.—Chloropicrin; hydrocyanic acid gas; carbon tetrachloride; ethylene oxide-carbon dioxide (injures germination of seed); cold storage; lime or road dust (mixed with supplies stored for seed).
Wireworms.—See NAPHTHALENE.

Carbon Tetrachloride. (See CARBON DISULFIDE AND ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE.)
Carpenter ants.—See ROTENONE-BEARING MATERIALS.
Stored-grain insects.—See ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE.
Weevils in beans and peas.—See CARBON DISULFIDE.

Chloropicrin.
Human lice.—See HYDROCYANIC ACID GAS.
Stored-grain insects.—See ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE; CALCIUM CYANIDE; HYDROCYANIC ACID GAS.
Weevils in beans and peas.—See CARBON DISULFIDE.

Creosote (Coal Tar).
Carpenter ants.—See ROTENONE-BEARING MATERIALS.
Chicken mites and ticks.—Anthracene oil (too thick to spray well without dilution with kerosene); crude petroleum (less penetrating and persistent).
Chinch bug (barriers).—Dust composed of Dinitroortho cresol with pyrophyllite and mineral oil; gas-tar oils; other coal-tar oils.
Dog fly or stable fly.—(As spray for immature stages in breeding media not to be used as fertilizer.) Gas-tar condensate.
Fleas.—(In chickenhouses and barnyards.) Crude petroleum or crankcase oil with kerosene (less effective); nicotine sulfate.—See ROTENONE-BEARING MATERIALS.
Lice (cattle).—See NICOTINE SULFATE.
Termites.—(Soil treatment for subterranean species.) Orthodichlorobenzene; pentachlorophenol; sodium arsenite; trichlorobenzene; crankcase oil. (Last less effective, usually used as a diluent.)

Cryolite.
Blister beetles on soybeans.—See ROTENONE-BEARING MATERIALS.
Bollworm on cotton.—See CALCIUM ARSENATE.
Cabbage caterpillars.—See ROTENONE-BEARING MATERIALS.
Codling moth.—See LEAD ARSENATE.
Corn earworm on lima beans.—No comparable substitute.
Cotton leafworm.—See CALCIUM ARSENATE.
Flea beetles.—See ROTENONE-BEARING MATERIALS.
Lettuce looper.—See ROTENONE-BEARING MATERIALS.
Lima bean pod borer.—No comparable substitute.
Melon worm.—See ROTENONE-BEARING MATERIALS.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Pepper weevil.—Calcium arsenate (often aphid infestations follow its use).
Plum curculio (on peach).—See LEAD ARSENATE.
Sugarcane borer.—No substitute.
Sweetpotato weevil.—See CALCIUM ARSENATE.
Tent caterpillar and other shade tree defoliators.—See LEAD ARSENATE.
Tobacco hornworms.—Paris green (inferior substitute in many regions—used in weak dilution and applied sparingly to prevent burning and poison residues).
Tomato fruitworm.—See CALCIUM ARSENATE.
Tomato pinworm.—No substitute.
White-fringed beetle.—See CALCIUM ARSENATE.
Velvetbean caterpillar.—Sodium fluosilicate or basic copper arsenate as a dust on soybeans; lead arsenate on peanuts.

Cube. See ROTENONE-BEARING MATERIALS.

Derris. See ROTENONE-BEARING MATERIALS.

Dichloroethyl Ether.
Corn earworm.—See PYRETHRUM.
Mushroom pests.—See CALCIUM CYANIDE.

Plum curculio (on peach).—See LEAD ARSENATE.
Wireworms.—See NAPHTHALENE.

Diphenylamine.

(Used as Formula 62 for screwworms and wool maggots.) Pine-tar oil much less effective. Wounds must be treated daily. Bone oil much less effective and toxic to animals if used too often.

Ethylene Dichloride-Carbon Tetrachloride Mixture.

Clothes moths and carpet beetles.—See NAPHTHALENE and HYDROCYANIC ACID GAS.
Dried-fruit insects.—See HYDROCYANIC ACID GAS and METHYL BROMIDE.
Gladiolus thrips (corms in storage).—See MERCURY COMPOUNDS and NAPHTHALENE.
Stored-grain insects.—(In elevators, warehouses, and mills.) See CALCIUM CYANIDE. (In farm-bin storage) carbon disulfide-carbon tetrachloride mixture; chloropicrin-carbon tetrachloride mixture; carbon disulfide (highly explosive but otherwise a good substitute).

Ethylene Dichloride Emulsion. (See PARADICHLOROBENZENE.)
Peach borer.—Paradichlorobenzene (sometimes injurious to young trees).

Ethylene Oxide-Carbon Dioxide Mixture.

Bedbugs.—See HYDROCYANIC ACID GAS.
Cigarette beetle and tobacco moth.—See CALCIUM CYANIDE.
Clothes moths, carpet beetles, and stored-grain insects.—(For use only in tight containers or compartments.) Ethylene dichloride-carbon tetrachloride mixture; carbon disulfide-carbon tetrachloride mixture.
Dried-fruit insects.—See HYDROCYANIC ACID GAS and METHYL BROMIDE.
Human lice.—See HYDROCYANIC ACID GAS.
Stored-grain insects.—See ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE; HYDROCYANIC ACID GAS.
Weevils in beans and peas.—See CARBON DISULFIDE.

Formaldehyde.

Housefly.—(Poison bait.) Sodium salicylate (1 percent in water with 10 percent brown sugar).
Mushroom pests.—Sulfur (burned in mushroom houses before putting in compost); hydrocyanic acid gas; calcium cyanide.

Hellebore.

Currant worm.—See LEAD ARSENATE.
Housefly.—(For treating manure.) Borax may be used.

Hydrocyanic Acid Gas.

Bedbugs.—Ethylene oxide-carbon dioxide mixture; methyl formate, methyl bromide (less effective and more expensive, but adaptable to fumigating individual rooms or apartments in congested areas); sulfur dioxide (2 lbs. of sulfur burned per thousand cubic feet; some fire hazard, metals tarnished, and delicate colors bleached); pyrethrum spray (pyrethrum extract in water-white kerosene is reasonably effective but cannot be relied upon to reach all bugs, necessitating repeated treatments); superheating (120°–125° F. for several hours; not applicable to poorly constructed buildings); corrosive sublimate (1 oz. in 1 pt. ethyl alcohol and 1 pt. turpentine for hand application; **highly poisonous**).
Carpet beetles and clothes moths.—Ethylene dichloride-carbon tetrachloride mixture (effective in tight compartments only); see also PARADICHLOROBENZENE and NAPHTHALENE.
Cigarette beetle and tobacco moth.—See CALCIUM CYANIDE. Liquid hydrocyanic acid used extensively in fumigation of tobacco in closed storage. Hydrocyanic acid gas produced by the pot method and calcium cyanide are inferior substitutes.
Clothes moth and carpet beetles.—See NAPHTHALENE.
Dried-fruit insects.—Methyl bromide, ethylene dichloride-carbon tetrachloride mixture; ethylene oxide-carbon dioxide mixture.
Greenhouse pests.—See CALCIUM CYANIDE.

Human lice.—(For fumigation of clothing and household effects.) Methyl bromide (air must be circulated); chloropicrin; ethylene oxide-carbon dioxide mixture; ethylene dichloride-carbon tetrachloride mixture.

Mushroom pests.—See FORMALDEHYDE.

Scale insects on citrus.—White-oil sprays (lower grade oils have been used successfully in Florida); rotenone.

Stored-grain and cereal pests.—(In warehouses and flour mills.) (In warehouses) methyl bromide preferable in very tight buildings; calcium cyanide; chloropicrin. (In mills) gas from liquid hydrocyanic acid is an efficient and widely used fumigant in mills which are piped for its use; the barrel or pot method of generating hydrocyanic acid gas from sodium cyanide; calcium cyanide; absorbent discoids containing liquid hydrocyanic acid (under some conditions); methyl bromide in very tight buildings; chloropicrin; superheating; "freeze-out." (In tight atmospheric vaults) methyl bromide; ethylene dichloride-carbon tetrachloride mixture either alone or plus 10 percent methyl bromide; ethylene oxide-carbon dioxide mixture; chloropicrin. (In vacuum vaults) methyl bromide; ethylene oxide-carbon dioxide mixture.

Weevils in stored beans and peas.—See CARBON DISULFIDE.

Lead Arsenate.

Alfalfa weevil.—See CALCIUM ARSENATE.

Apple maggot.—Calcium arsenate.

Bollworm.—See CALCIUM ARSENATE.

Codling moth.—Calcium arsenate for use in areas where pest is readily controlled, such as parts of Hudson Valley and New England. (Less effective and likely to cause foliage injury.) Cryolite and barium fluosilicate (effective in arid regions). Nicotine sulfate and summer-oil emulsion (not available in sufficient quantity to meet all spray needs but may be used to replace some arsenical applications except on apple foliage carrying deposits of sulfur materials. Should not be used in combination with sulfur). Nicotine-bentonite (effective in Middle West but of less value in Northwest; loses effectiveness if mixed with strongly alkaline fungicides, such as lime sulfur or bordeaux mixture, or on foliage covered with those materials). Xanthone (has given moderately good results in the Northwest; less so in East and has tendency to russet fruit in early-season applications).

Colorado potato beetle.—Calcium arsenate; paris green; cryolite; rotenone.

Corn earworm.—Used as a dust on sweet corn, tassels, and whorls before ears form. See PYRETHRUM.

Cotton leafworm.—See CALCIUM ARSENATE.

Currant worm.—Hellebore.

Earthworms.—(Lawns and turf.) Mercuric chloride solution; Mowrah meal.

Grape berry moth.—Calcium arsenate; nicotine bentonite.

Gladiolus thrips.—See TARTAR EMETIC.

Hornworm on tobacco.—See CRYOLITE.

Japanese beetle (adult).—Hydrated lime (used as a repellent with aluminum sulfate, fish oil, or linseed oil as a sticker). Rotenone.

Japanese beetle (grubs) and whitegrubs in soil.—No available substitute.

Peach twig borer.—Lime-sulfur (applied in late-dormant period); nicotine sulfate (used with soap); hydrated lime (applied as dust).

Pecan leaf casebearer.—See CALCIUM ARSENATE.

Pecan nut casebearer.—Nicotine sulfate and summer oil; tar-oil sprays (applied in dormant period).

Plum curculio (on apple).—No adequate substitute.

Plum curculio (on peach).—Barium fluosilicate and cryolite (occasionally injures fruit); dichloroethyl ether (in early experimental stages as soil treatment; would be especially useful in South where two broods of curculio occur).

Raspberry fruitworm.—See ROTENONE-BEARING MATERIALS.

Sod webworms.—Pyrethrum extract; kerosene emulsion.

Tent caterpillars and other shade-tree defoliators.—Calcium arsenate (likely to injure tender foliage; addition of hydrated lime reduces this danger); cryolite (does not adhere well); nicotine sulfate (effective against young larvae of many species); rotenone dusts (too expensive for general use).

Tobacco budworm.—No comparable substitute.

Vegetable weevil.—See CALCIUM ARSENATE.

Lime-Sulfur.

No likelihood of scarcity. Used as a contact spray, especially against scale insects, spider mites and potato psyllid.

Magnesium Arsenate.

Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.

Mercury Compounds (including corrosive sublimate and calomel).

Bedbugs (corrosive sublimate).—See HYDROCYANIC ACID GAS.
Cabbage maggot.—No adequate substitute.
Earthworms.—Lead arsenate; tobacco dust; limewater.
Gladiolus thrips.—(Corms in storage.) See CALCIUM CYANIDE for fumigants. As a dip no satisfactory substitutes.
Millipeds and sowbugs.—Paris green (used on waste fruit or vegetables as bait).
Onion maggot.—Lubricating oil emulsion (a lubricating oil emulsion with bordeaux mixture is useful).

Metaldehyde.

Slugs and snails.—(In bait.) paris green; calcium arsenate; white arsenic; sodium fluosilicate.

Methyl Bromide.

Ants.—See CARBON DISULFIDE.
Bedbugs.—See HYDROCYANIC ACID GAS.
Dried-fruit insects.—Hydrocyanic acid gas; ethlene dichoride-carbon tetrachloride mixture and ethylene oxide-carbon dioxide mixture.
Human lice.—See HYDROCYANIC ACID GAS.
Stored-grain and cereal pests.—See CALCIUM CYANIDE; ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE MIXTURE; HYDROCYANIC ACID GAS.

Methyl Formate-Carbon Dioxide Mixture. (See HYDROCYANIC ACID, CALCIUM CYANIDE, and ETHYLENE DICHLORIDE-CARBON TETRACHLORIDE.)
Bedbugs.—See HYDROCYANIC ACID GAS.
Cigarette beetle and tobacco moth.—See CALCIUM CYANIDE.

Molasses.

Boll weevil.—(Used in presquare poisoning.) Calcium arsenate dust.
Boxwood leaf miner.—Molasses, nicotine sulfate, and water; substitute 2 percent nicotine dust.
Flies.—(Used as bait for houseflies and blowflies.) Stale beer, bran, yeast, milk, kitchen refuse, and other fermenting waste.
Gladiolus thrips.—(For use as bait spray.) See BROWN SUGAR.

Naphthalene.

Clothes moth and carpet beetles.—Paradichlorobenzene; ethylene dichoride-carbon tetrachloride mixture (in trunks or closed compartments); hydrocyanic acid gas (dangerous).
Fleas in houses.—Pyrethrum oil sprays (only kills insects struck).
Gladiolus thrips.—Mercuric chloride; calcium cyanide; ethylene dichloride-carbon tetrachloride.
Psocids.—See PYRETHRUM.
Wireworms.—Calcium cyanide (as soil fumigant; fairly effective in California); carbon disulfide (too expensive for use except in small areas); dichloroethyl ether (particularly under California conditions certain crops, especially beans, are injured).

Nicotine Bentonite.

Codling moth.—See LEAD ARSENATE.
European corn borer.—See ROTENONE-BEARING MATERIALS.
Grape berry moth.—See LEAD ARSENATE.

Nicotine Sulfate.

Aphids on cotton.—Rotenone-bearing dusts (¾ percent–1 percent).
Aphids and thrips on greenhouse plants.—Rotenone, pyrethrum, sulfonated castor oil used as a spray.
Aphids on trees.—Summer oil emulsion (may injure tender foliage).
Aphids on truck crops.—Rotenone materials; soap (strong soap suds, especially fish-oil soap, valuable against the bean aphid and certain other species).
Boxwood leaf miner.—See MOLASSES.

Chinch bug.—(Used in spray alone or in emulsion of refined mineral oil for chinch bug on corn.) Derris extract in oil emulsion. (For chinch bugs in lawns); rotenone dusts; tobacco dust; soap solution.
Codling moth.—See LEAD ARSENATE.
Cucumber beetles.—Rotenone dust and calcium arsenate-bordeaux mixture.
Fleas.—Creosote oil can be used where staining, injury to plants, and odor are not objectionable.
Gladiolus thrips.—See TARTAR EMETIC.
Grape leafhopper.—Pyrethrum extracts in concentrated form applied in vaporized light oil; rotenone extracts applied as sprays; calcium cyanide as dust.
Lice.—

Cattle: Coal-tar cresote dips; rotenone as dusts or dips; arsenical dips; wettable sulfur and rotenone.
Chicken: Sodium fluoride applied to fowls as dust or dip.
Goat: Wettable sulfur; arsenical dips.
Hog: Crank case oil applied to animals.

Mealybug.—Organic thiocyanates—fairly effective as sprays; may injure tender foliage. Tender plants should be sprayed with clear water on or after treatment.
Peach twig borer.—See LEAD ARSENATE.
Pecan nut casebearer.—See LEAD ARSENATE.
Squash borer.—Rotenone dusts.
Squash bug.—Rotenone or pyrethrum as a spray or dust; insecticides are not effective against the adults.
Tent caterpillar and other shade tree defoliators.—See LEAD ARSENATE.
Thrips.—

Gladiolus: See TARTAR EMETIC.
Greenhouse: Derris; pyrethrum; sulfonated castor-oil spray; tartar emetic; organic thiocyanates (see TARTAR EMETIC).
Iris: Rotenone; tobacco powder.
Onion: Rotenone; tartar emetic.
Tobacco: Pyrethrum (preferable to nicotine).

Ticks.—May be mixed with sodium fluoride in a spray for the control of adults on grass and other vegetation. Care should be taken in spraying valuable foilage, since this mixture may burn it.
White flies.—(In greenhouses.) Rotenone (derris-pyrethrum-sulfonated castor-oil spray); white-oil emulsion (less effective); calcium cyanide. (See ROTENONE-BEARING MATERIALS. White flies.)

Orthodichlorobenzene.

Ants.—See CARBON DISULFIDE.
Powder-post beetles.—Sulfur or borax (applied as a dip to green lumber, as repellent); pentachlorophenol and linseed oil (applied to seasoned lumber); turpentine and kerosene mixture, and kerosene (used on seasoned articles and furniture); coal-tar creosote and kerosene mixture (where staining is not objectionable).
Termites (subterranean).—See CREOSOTE.

Paradichlorobenzene.

Clothes moth and carpet beetles.—Flaked naphthalene. (See HYDROCYANIC ACID GAS.)
Peach borer.—Ethylene dichloride emulsion (some danger of injury in certain heavy soils).
Psocids.—See PYRETHRUM.
Silverfish.—See ARSENIC.

Paris Green.

Ants.—See SODIUM ARSENITE.
Armyworms.—See SODIUM ARSENITE.
Cabbage caterpillars.—See ROTENONE-BEARING MATERIALS.
Colorado potato beetle.—Calcium arsenate; lead arsenate; cryolite; rotenone.
Cotton leafworm.—Calcium arsenate; lead arsenate; cryolite (less effective).
Cranefly larvae.—(In bran bait for range craneflies.) Sodium arsenite, white arsenic, or sodium fluosilicate might be satisfactory substitutes but have not been tried.
Cutworms.—(For use in bait.) See ARSENIC.
Gladiolus thrips.—See TARTAR EMETIC.

Grasshoppers.—See SODIUM ARSENITE.
Lettuce looper.—See ROTENONE-BEARING MATERIALS.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Millipeds.—See MERCURY COMPOUNDS.
Mosquitoes.—See PYRETHRUM.
Plant bugs on cotton.—Calcium arsenate.
Slugs and snails.—See METALDEHYDE.
Tobacco crambid (or sodworm).—No adequate substitute.
Tobacco flea beetle.—Calcium arsenate; cryolite; rotenone.
Tobacco hornworms.—See CRYOLITE.
Vegetable weevil.—(As dust or spray.) Calcium arsenate; cryolite; lead arsenate; sodium fluosilicate; sodium fluoride in poisoned baits.
Webworms.—See CALCIUM ARSENATE.

Pentachlorophenol. (See CREOSOTE, *Termites;* ORTHODICHLOROBENZENE (*Powder-post beetles*).
Termites (subterranean).—See CREOSOTE.

Phenothiazine.
Mosquitoes.—See PYRETHRUM.

Phosphorus Paste.
Cockroaches.—See SODIUM FLUORIDE.
Silverfish.—See ARSENIC.

Potassium Sulfide.
Red spider.—See SULFUR, ROTENONE, and ORGANIC THIOCYANATES.

Pyrethrum.
Ants.—See CARBON DISULFIDE.
Aphids.—
Cabbage: See ROTENONE-BEARING MATERIALS.
Greenhouse: See NICOTINE SULFATE.
Bedbugs.—See HYDROCYANIC ACID GAS.
Beet leafhopper.—No comparable substitute.
Blister beetles.—See ROTENONE-BEARING MATERIALS.
Cabbage caterpillars.—See ROTENONE-BEARING MATERIALS.
Celery leaf tier.—No substitute.
Celery looper.—See ROTENONE-BEARING MATERIALS.
Cockroaches.—Sodium fluoride; borax and phosphorus paste.
Corn earworm on sweet corn.—(Tasteless, odorless extract in refined mineral oil injected into silks after pollination.) Dichloroethyl ether (may leave odor or taste if temperatures are low after treatment); styrene dibromide.
Crickets.—Sodium fluosilicate in bait; organic thiocyanates as sprays (partial substitute).
Fleas.—See ROTENONE; NAPHTHALENE.
Flies.—Organic thiocyanates and thiocyanoacetates (partial substitutes used as sprays, preferably in combination with pyrethrum); sesame oil (as an activator with pyrethrum); derris or cube extracts (can be used for part of pyrethrum).
Grape leafhopper.—See NICOTINE SULFATE.
Japanese beetle.—(For destruction of adults) soap sprays.
Leafhopper.—(On potatoes and beans) bordeaux mixture (especially valuable on potatoes and peanuts); sulfur (particularly useful on beans and peanuts); may cause foliage burning on some plants, as cucumbers, eggplants, and raspberries; sulfur-pyrethrum on alfalfa.
Lettuce looper.—See ROTENONE-BEARING MATERIALS.
Lice (cattle).—See ARSENICAL DIPS. *Lice (human).* See ROTENONE-BEARING MATERIALS.
Melon worm and pickleworm.—See ROTENONE-BEARING MATERIALS.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Mosquitoes.—(As oil sprays.) Organic thiocyanates; thiocyanoacetates (likely to be injurious to user if much exposed) (as larvicides); pyrethrum oil emulsion; fuel oil; paris green (against *Anopheles* and certain other species); phenothiazine (1 part in 20 parts sulfonated petroleum oil and 5 parts acetone).
Mushroom pests (including mushroom flies, manure flies, and other species).—See CALCIUM CYANIDE and FORMALDEHYDE.
Plant bugs (Lygus).—(On sugar beets for seed.) No comparable substitute; sulfur useful in controlling light infestations.

Psocids.—Paradichlorobenzene (as fumigant in tight compartments); sodium fluoride as a dust; gasoline (for drenching infested upholstered furniture; must be done outdoors); rotenone powders; flaked naphthalene (in closed closets and rooms).

Silverfish.—Paradichlorobenzene in carbon tetrachloride as spray. See ARSENIC.

Sod webworms.—See LEAD ARSENATE.

Squash bug.—See NICOTINE SULFATE.

Stored-grain insects.—Thiocyanates used instead of pyrethrum in some odorless kerosene sprays.

Thrips.—

Greenhouse: See ROTENONE and NICOTINE SULFATE.
Tobacco: Nicotine (a poor substitute).
Webworms: Paris green; calcium arsenate.
White flies: See ROTENONE.

Rotenone-Bearing Materials (Derris, Cube, Timbo).

Ants (in lawns).—See CARBON DISULFIDE, SODIUM ARSENITE and SODIUM FLUORIDE.

Aphids.—Nicotine sulfate; for control of pea aphid, nicotine dust mixture must be applied with a trailing canopy at least 40 feet in length and when air temperature is above 65° F. and vines are dry. When nicotine is used against turnip aphid, melon or cotton aphid, and many other species of aphids the temperatures must be 65° or above and the foliage dry.

Aphids and thrips on greenhouse plants.—See NICOTINE SULFATE.

Aphids on truck crops.—See NICOTINE SULFATE.

Asparagus beetle.—No adequate substitute. Arsenicals unsatisfactory on edible shoots because of residue hazard.

Blister beetles.—Pyrethrum (used as spray or dust mixture); sodium fluosilicate (dilute with five times its weight of clay; some foliage injury may result); calcium arsenate (dusts or sprays will repel beetles).

Cabbage caterpillars.—Calcium arsenate for the diamondback moth caterpillar; paris green or cryolite for the imported cabbageworm; pyrethrum or cryolite for the cabbage looper. (Poison residue important; cabbage to be sold as U. S. Grade No. 1 should not be dusted or sprayed with calcium arsenate, paris green, or cryolite after the heads begin to form.)

Carpenter ants.—Sodium fluoride; coal-tar creosote and gasoline (equal parts suitable for treatment of poles); carbon disulfide and carbon tetrachloride.

Cattle grubs.—As partial substitutes—hand extraction (avoid crushing grubs), benzol and carbon tetrachloride injected into openings with oil can; petrolatum 5 parts, iodoform 1 part (applied to openings in skin).

Celery looper.—Pyrethrum as dust or spray or as "impregnated dust."

Chinch bug.—See NICOTINE SULFATE

Colorado potato beetle.—Calcium arsenate; lead arsenate; cryolite; paris green.

Cucumber beetles.—Bordeaux mixture; nicotine sulfate; calcium arsenate (repels beetles; treatment should be discontinued after fruits begin to form).

European corn borer.—(Practical only on sweet corn in home gardens or for marketing green.) Nicotine bentonite spray; nicotine tannate spray; dual-fixed nicotine dust.

Flea beetles.—Bordeaux mixture (alone or in combination with calcium arsenate of value in repelling flea beetles from vegetables and flowering plants; may injure foliage; much inferior to rotenone); calcium arsenate (comment as above); cryolite; barium fluosilicate.

Fleas.—(For use on pet animals.) Pyrethrum; coal-tar creosote dips.

Grape leafhopper.—See NICOTINE SULFATE.

Harlequin bug.—No comparable substitute.

Japanese beetle (adult).—Lead arsenate and substitutes therefor.

Lettuce looper.—Pyrethrum; paris green (should not be applied after heads begin to form); cryolite and calcium arsenate (comment as above).

Lice.—

Cattle: See ARSENICAL DIPS.
Goat: Wettable sulfur.
Human: Pyrethrum; kerosene-soap (for head lice); mercuric ointment (for pubic lice—**poisonous,** use with care).

Melon worm and pickleworm.—Pyrethrum (inferior but can be used with clay or talc and sulfur to protect fall-grown squash; no satisfactory control has been developed for use on cucumbers, melons, and pumpkins); cryolite (mixed with clay and sulfur may be used in early treatments).

Mexican bean beetle.—Cryolite (partial substitute; should not be used after pods begin to form); pyrethrum (additional treatments are required to give same degree of control); calcium arsenate (danger of poison residues and injury to plants; this is lessened by adding 4 pounds hydrated lime to each pound of the arsenical when used as a spray and 7 or 8 pounds hydrated lime to each pound when used as a dust); magnesium arsenate (partial substitute but poison residue and injury to foliage must be considered); zinc arsenite (has a limited use under semiarid conditions; also poisonous); barium fluosilicate and sodium fluosilicate (much less effective and likely to burn foliage).

Pea weevil.—No comparable substitute. Calcium arsenate is of some value in combating pea weevils on nonedible peas.

Psocids.—See PYRETHRUM.

Raspberry fruitworm.—No comparable substitute. (Lead arsenate is of some value for early treatments but should not be used after blossom buds open.

Red spider.—Potassium sulfide (used as a spray with soap at weekly intervals); organic thiocyanates (very effective but may injure certain plants; materials should be washed from tender plants 1 hour after treatment); sulfur; fish-oil soap; kerosene emulsion.

Scale insects on citrus.—Hydrocyanic acid gas; oil sprays.

Strawberry weevil.—See CALCIUM ARSENATE.

Squash borer.—Nicotine sulfate.

Squash bug.—See NICOTINE SULFATE.

Tent caterpillar and other shade tree defoliators.—See LEAD ARSENATE.

Thrips.—

Greenhouse: Tartar emetic (apply with brown sugar as a spray); pyrethrum as spray (less effective than rotenone or tartar emetic); nicotine sulfate with soap (fairly effective against younger stages); thiocyanates (may injure certain plants; wash material off tender plants 1 hour after application).

Iris: Tobacco powder; nicotine sulfate.

Onion: Nicotine sulfate; tartar emetic (with brown sugar as spray).

Ticks.—(As a dip or dust for the control of Rocky Mountain spotted fever ticks and brown dog ticks on dogs.) No satisfactory substitute. Hand picking of some value.

White flies (in greenhouses).—White mineral oil emulsion (less effective); white mineral oil emulsion and nicotine sulfate; calcium cyanide (dangerous).

Sodium Antimony Lactophenolate.

Gladiolus thrips.—See TARTAR EMETIC.

Sodium Arsenite.

Ants.—(In baits.) Sodium arsenate; tartar emetic; paris green; thallium sulfate. These materials, particularly the last, are deadly poisons. To be effective the baits must be made according to exact formulas.

Armyworms.—White arsenic; paris green; sodium fluosilicate.

Cranefly.—See PARIS GREEN.

Cutworms.—See ARSENIC.

Grasshoppers.—(In baits.) Sodium fluosilicate; white arsenic; paris green.

Mormon cricket.—In contact dust only. See SODIUM FLUOSILICATE.

Termites (subterranean).—See CREOSOTE.

Sodium Cyanide.—See HYDROCYANIC ACID GAS.

Mushroom pests.—See CALCIUM CYANIDE.

Stored-grain and mill insects.—See HYDROCYANIC ACID GAS.

Sodium Fluoride.

Ants.—(As a repellent or contact insecticide.) Pyrethrum dust or spray; rotenone powder. (In bait.) See SODIUM ARSENITE.

Cockroaches.—Sodium fluosilicate (used as a dust; less effective because too coarse); phosphorus paste (particularly applicable to humid regions and for the larger species); pyrethrum oil sprays (must be brought in contact with cockroaches at the time of application); borax; pyrethrum (used as dust).

Lice (chicken).—See NICOTINE SULFATE.

Lice (on livestock).—See ARSENICAL DIPS.

Psocids.—*See* PYRETHRUM.

Silverfish.—See ARSENIC.
Ticks.—See NICOTINE SULFATE.
Vegetable weevil.—(For use in baits) See CALCIUM ARSENATE.

Sodium Fluosilicate.

Armyworms.—See SODIUM ARSENITE.
Blister beetles.—See ROTENONE-BEARING MATERIALS.
Cockroaches.—See SODIUM FLUORIDE.
Cranefly.—See PARIS GREEN.
Crickets.—See PYRETHRUM.
Cutworms.—See PARIS GREEN.
Grasshoppers.—See SODIUM ARSENITE.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.
Mole crickets.—See CALCIUM ARSENATE.
Mormon cricket.—(In baits.) Sodium arsenite (in contact dust only).
Slugs and snails.—See METALDEHYDE.
Vegetable weevil.—See CALCIUM ARSENATE.
Velvetbean caterpillar.—See CRYOLITE.

Sodium Salicylate.

Housefly.—See FORMALDEHYDE.

Sulfur.

There is little likelihood this material will become unavailable.

Tartar Emetic.

Ants.—See SODIUM ARSENITE.
Citrus thrips.—Lime-sulfur; sulfur dust.
Gladiolus thrips.—Sodium antimony lactophenolate; paris green (with molasses, fairly effective but may injure foliage; if brown sugar used, more required than with tartar emetic); lead arsenate and brown sugar (fairly effective but leaves objectionable white deposit; also requires more brown sugar); nicotine sulfate (with brown sugar; less persistent than other materials mentioned, thus requiring frequent applications).
Greenhouse thrips.—See ROTENONE-BEARING MATERIALS.
Onion thrips.—See NICOTINE SULFATE.

Thallium Sulfate.

Ants.—(In bait.) See SODIUM ARSENITE.

Thiocyanates (Organic).

Crickets.—See PYRETHRUM.
Flies.—See PYRETHRUM.
Mealybug.—See NICOTINE SULFATE.
Mosquitoes.—See PYRETHRUM.
Red spider.—See ROTENONE-BEARING MATERIALS.
Stored-grain insects.—See PYRETHRUM.
Thrips (greenhouse).—See NICOTINE SULFATE.

Thiocyanoacetates.

Flies.—See PYRETHRUM.
Mosquitoes.—See PYRETHRUM.

Tobacco Dust.

Chinch bug.—See NICOTINE SULFATE.
Earthworms.—See AMMONIUM SULFATE.
Thrips (iris).—See NICOTINE SULFATE.

Trichlorobenzene.

Termites.—See CREOSOTE.

Xanthone.

Codling moth.—See LEAD ARSENATE.

Zinc Arsenite.

Alfalfa weevil.—See CALCIUM ARSENATE.
Mexican bean beetle.—See ROTENONE-BEARING MATERIALS.

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